Intellectual Property Office of New Zealand

NZ00/00127

CERTIFICATE

4

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 16 July 1999 with an application for Letters Patent number 336795 made by STRATEGIC GROUP LTD.

Dated 24 July 2000.

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH
RULE 17.1(A) OR (B)

Neville Harris
Commissioner of Patents

COMMISSIONER OF PATENTS, TRADE MARKS & DESIGNS
NEW ZEALAND

Patents Form No. 4 Our Ref: MF801968

Patents Act 1953

PROVISIONAL SPECIFICATION

PHOTO-LUMINESCENT PIGMENT APPLICATION

We, **STRATEGIC GROUP LIMITED,** a New Zealand company, of 19 Lindsay Street, Christchurch New Zealand do hereby declare this invention to be described in the following statement:

PT0425909

Photo-luminescent Pigment Application

Field of the Invention

The invention relates to a method and apparatus for applying photo-luminescent pigment to a substrate surface, more particularly for applying photo-luminescent pigment to aluminium extrusions such as those as stair nosings. The invention also relates to a product produced by said method and apparatus.

Background to the Invention

Low level floor or walkway lighting is commonly used in such places as picture theatres, sports arenas, aircraft and the like as both a courtesy and safety feature for patrons or passengers. This lighting often takes the form of an electrical or electronic lighting means in or on the floor along either side of a walkway or across the nosing of stairs. Low level floor lighting is particularly important in picture theatres and sports arenas where patrons may be required to negotiate steps in aisles when only low levels of ambient light are present, or in stairwells of buildings during an emergency when there may be failure of the main lighting source.

Known methods of floor lighting using electrical or electronic means have a disadvantage because they require electrical wiring to be run to areas where access for such wiring may be limited. They are also prone to failure during failure of the main power supply. Additionally, these electronic lighting

means are often of a low voltage variety requiring some form of voltage reduction means such as an inverter, converter, or transformer. Not only does addition of such equipment add to the complexity and cost of the installation but also provides for additional modes of failure.

It is known to apply a photo-luminescent pigment to a rope, tape or fabric. This photo-luminescent pigment is stimulated by visible light and remains luminescent for a considerable period after the light source is removed. The problem with tape or fabric impregnated with pigment is that lacks durability for heavy wear areas such as walkways or stairs.

Photo-luminescent pigment has been sprayed onto more durable substrate surfaces such as aluminium extrusion. Once the spray has dried, it is usually ground to provide a smooth finished surface. This overcomes the abovementioned problems associated with heavy wear areas, but considerable pigment is wasted during the spraying and grinding process.

Accordingly it is an object of the present invention to provide a method and apparatus for applying photo-luminescence pigment to a substrate which avoids or overcomes some of the abovementioned disadvantages, or which at least provides the public with a useful choice.

Summary of the invention

According to a first aspect of the invention there is a method for applying photo-luminescent pigment to a substrate for illuminating walkways and step nosings, said method including:

preparing a dry powder formulation comprising a photo-luminescent pigment, a heat curable polymer;

depositing said dry powder formulation onto a substrate surface;

heating the substrate surface and dry powder formulation until said dry powder formulation becomes solidly fused to the substrate surface.

Preferably the dry powder formulation may include small quantities of additives to ensure a smooth surface finish.

Preferably the volume ratio of photo-luminescent pigment to a heat curable polymer in the dry powder formulation as such that the fused material exhibits substantially the same strength and durability properties of the curable polymer, while still exhibiting the photo-luminescent properties of the pigment.

More preferably the volume ratio is substantially in the range of 1% to 70% photo-luminescent pigment to curable polymer.

Preferably the substrate surface has depressions or channels adapted to receive the dry powder formula.

Preferably the dry powered formulation may be heated to substantially between 160 to 200 degrees centigrade, or a temperature recommended by the manufacturer of the curable polymer, for approximately 10 to 20 minutes, or until the formula is molten.

Preferably said substrate is stamped, extruded or milled aluminium. More preferably the aluminium is a stair noising.

According to a second aspect of the invention there is an apparatus for applying photo-luminescent pigment to a substrate surface, said apparatus including:

a hopper adapted to contain a dry powder formulation;

a orifice adapted to allow transfer of the dry powder formulation from the hopper to a substrate surface;

a guide rail system for locating the substrate surface in both a fixed horizontal plane and a fixed vertical plane below said hopper and orifice; and

a heat-curing system for providing enough heat to turn the dry powder formulation into a molten mix.

Preferably the apparatus may include a drive system to move the substrate surface.

Preferably the apparatus includes a support roller mounted directly beneath the orifice and hopper, which supports the substrate.

Preferably the apparatus includes an adjustable mounting bracket adapted to enable the hopper be located in the correct position so that the orifice lines up with the substrate.

Preferably the orifice is adapted to communicate snugly with the substrate surface such that the dry powder formula is deposited substantially only where required.

Preferably the apparatus includes a mechanism for tapping the hopper so that any rat-holes in the dry powder formula are re-filled;

Preferably the apparatus includes a brush vertically mounted below the roller, with its bristles in contact with the roller, such that any powder that falls onto the roller is subsequently brushed off.

The heat-curing system may be an oven such that after the substrate surface has been deposited with the dry powder formulation it is placed in the oven for the required time. Optionally the heat-curing system may be a continuous oven process.

Preferably the apparatus includes an automatic loading and unloading means at each end thereof.

The invention also provides for a product when produced according to the process herebefore defined.

Brief Description of the Drawings

An example of the invention will now be described with reference to the accompanying drawings in which:

FIGURE 1: illustrates a perspective cross section through a typical hopper arrangement; and

FIGURE 2: illustrates an elevation of the typical hopper and feed table.

Description of the Invention

The invention relates to a method and apparatus used for applying a photo luminescent formulation to extruded aluminium stair nosing substrates and the like. The finished stair nosing and be luminescent for an extended period after ambient illumination is switched off, and hence maintain the safety of spectator areas in picture theatres, sporting arenas and the like in low light situations. The resulting photo-luminescent extrusions could also find application in aircraft aisles and building stairways where floor lighting is adapted in guiding people to an exit in an emergency when normal lighting fails.

The process involves filling depressions or channels in a substrate material (typically but not exclusively an aluminium extrusion or stamped or milled sheet of aluminium) with a dry powder formulation that contains a photo luminescent pigment; a heat curable polymer; and small quantities of additives that improve the melt properties of the mix and ensure a smooth surface finish. When sufficient heat is applied to the combined formulation, the combined formulation becomes solidly fused to itself and to the substrate.

The depressions or channels in the substrate are filled up with the dry powder formulation so as to be level with the top surface of the substrate material, but when fused with heat, the air between the dry particles is expelled, and the fused material forms a thick film that smoothly covers both the horizontal and vertical surfaces of the depressions or channels in the substrate.

The ratio of photo-luminescent pigment to curable polymer in the dry powder formulation is dependent on the intensity and duration of illumination wanted. If greater intensity and duration of illumination is required, more pigment is added. A typical formulation will contain between 30% and 60% photo luminescent pigment powder by weight. However, because the specific gravity of the powder is typically 3-4 times greater than the rest of the dry powder formulation, the photo luminescent pigment volume ratio is typically in the range 10% to 30%. Because the photo-luminescent pigment makes up a relatively small part of the total volume of the fused material, the

fused material exhibits substantially the same strength and durability properties that the heat curable polymer would have without the inclusion of the photo luminescent pigment, but it also has the added property of being photo-luminescent. Success has been obtained with volume ratio as high as 70% photo-luminescent pigment.

The principle of the process is to pass the substrate material with the channels or depressions in it, facing upwards, below a hopper which is filled with the dry powder formulation. The hopper has a bottom orifice, and the shape of the bottom orifice of the hopper is chosen so that the dry powder formulation will fall under its own weight into the channels or depressions, and will not spill on either side of the substrate. As the substrate passes under the hopper, the lower surface of the bottom orifice wipes the top surface of the substrate material clean, so that the only dry powder formulation that is removed from the hopper is that which fills the channels or depressions, and those channels or depressions are filled to be level with the top surface of the substrate. Heat is then applied to cure the dry powder formulation.

Individual pieces of the substrate material are successively passed underneath the hopper in such a way that no substantial quantities of the dry powder formulation fall between the tail end of one piece and the lead edge of the subsequent piece.

The essential components of the photo-luminescent pigment application equipment will now be described with reference to Figures 1 and 2.

The apparatus includes a guide rail system 8 for locating the individual substrate pieces, in this case aluminium extrusions 1, in both a fixed horizontal plane and a fixed vertical plane.

A drive system (not shown) is required for pushing the individual substrate pieces passed (below) a hopper 2. This drive system may be a human operator, or it may be a system of motorised rollers that engage with one or two faces of the individual substrate pieces. For example, support roller 3 may be motorised to drive the extrusions 1 below hopper 2.

The hopper 2 preferably has steep sides, to avoid build-up of product, and can hold typically but not exclusively 1-1.5 kg of dry powder formulation. The hopper 2 shown in figure 1 is cut-away for illustration purposes.

A mechanism (not shown) for tapping the hopper 2 at regular intervals, so that any "rat-holes" in the dry power are re-filled. Typically the tapping action will occur once every 30-60 seconds of operation, which is not enough to allow the different components of the dry powder formulation to separate substantially. In its simplest form, this "mechanism" may in fact be the hand of a human operator, but ideally this function is carried out by a solenoid or air actuated arm. Alternatively an auger or screw may be

included which either continuously or intermittently "mixes" the formula, thereby filling any "rat holes".

An adjustable mounting bracket 4 to enable the hopper 2 to be located in the correct position so that bottom orifice 5 lines up with the channels or depressions in the extrusion 1. Orifice 5 may be formed in a die 9, which is adapted to suit the extrusion 1 being used. The die 9 would butt snugly over extrusion 1 so that no formula was spilled or wasted.

A compressible foam rubber insert 7 between the hopper body 1 and the bottom orifice 5, which suspends the bottom orifice 5 in such a way that it will still seal against the extrusion 1 even if the extrusion 1 is not perfectly lined up.

A support roller 3 mounted directly beneath the bottom orifice 5 of the hopper 2, which supports the extrusion 1 without imposing excessive friction, such that the extrusions 1 can be readily pushed through the system by hand if necessary.

A bristle brush (not shown) vertically mounted directly below the roller 3, with its bristles in contact with the roller, such that any powder that falls onto the roller is subsequently brushed off, and not allowed to build up on the roller.

A heat-curing system (not shown) for providing enough heat to turn the dry powder formulation into a molten mix, and bond it to the substrate. This may typically be an oven with a racking system, such that after the individual substrate pieces have had their channels or depressions filled with the dry powder formulation, they are loaded by hand onto the racks. When the racks are full, these racks are placed in the oven for the required time. Using this system a typical curing cycle may be 10-20 minutes at 160°C to 200°C. Optionally the heat-curing system may be a continuous tunnel process, such that after the individual substrate pieces have had their channels or depressions filled with the dry powder formulation, they immediately enter a curing tunnel that rapidly heats them to typically 160°C to 200°C for a sufficient time to turn the dry powder formulation into a molten mix, and bond it to the substrate. The individual substrate pieces then emerge from the opposite end of the tunnel.

The above-described system may be fully automated if required by the use of automatic loading and unloading magazines at each end of the production line. Automation of such a system is well within the capability of one skilled in the art and will not be discussed further.

The following description of the photo-luminescent pigment application process is given by way for example only, to illustrate the invention.

A representative piece of substrate is placed on the guide rail close to the empty hopper, then passed into the gap between the bottom orifice of the

hopper and the support roller. The position of the hopper assembly is adjusted as necessary to ensure that the bottom orifice lines up with the channels or depressions in the substrate, and there are no gaps to either side that would let powder escape.

The hopper is then filled with a thoroughly mixed quantity of the dry powder formulation.

The first piece of "production" substrate is then placed on the guide rail immediately behind the representative piece of substrate, and moved towards the hopper assembly. In this way it pushes the representative piece of substrate through and passed the hopper assembly, and onto the guide rail on the other side of the hopper assembly. The representative piece of substrate can subsequently have the powder that has been applied to it removed by a vacuum cleaning head, and then the substrate can be reused as a plug for the hopper's bottom orifice whenever production is halted.

Before the first piece of production substrate is pushed right through the hopper assembly, the second piece of production substrate is picked up off a magazine, and placed on the guide rail immediately behind the first piece of production substrate. Once the first piece of production substrate is away from the hopper assembly it can be taken off the guide rail and placed on racks ready for oven curing.

The above step is then repeated until the racks are full. The racks are then placed in the oven for the required curing cycle, then removed from the oven and allowed to cool before final inspection and packaging.

At regular intervals as required, the hopper is tapped to remove "rat-holes" in the powder, and the hopper is refilled with thoroughly mixed dry powder formulation.

When the production run has finished, the representative piece of substrate can be reused as a plug for the hopper's bottom orifice, and finally any left-over powder can be removed from the hopper.

It can readily be seen that whereas the above description describes the method of operation for a non-mechanised form of the equipment, the process can readily be automated using the optional automating equipment described above, so that the process becomes either semi-automatic, or fully automatic. Such automation would be well within the capabilities of the normally skilled person.

Where in the foregoing description reference has been made to integers or elements having known equivalents, then such equivalents are herein included as if individually set forth.

Particular examples of the invention have been described and it is envisaged that improvements and modifications can take place without departing from the scope thereof.

STRATEGIC GROUP LIMITED

By their Attorneys
BALDWIN SHELSTON WATERS

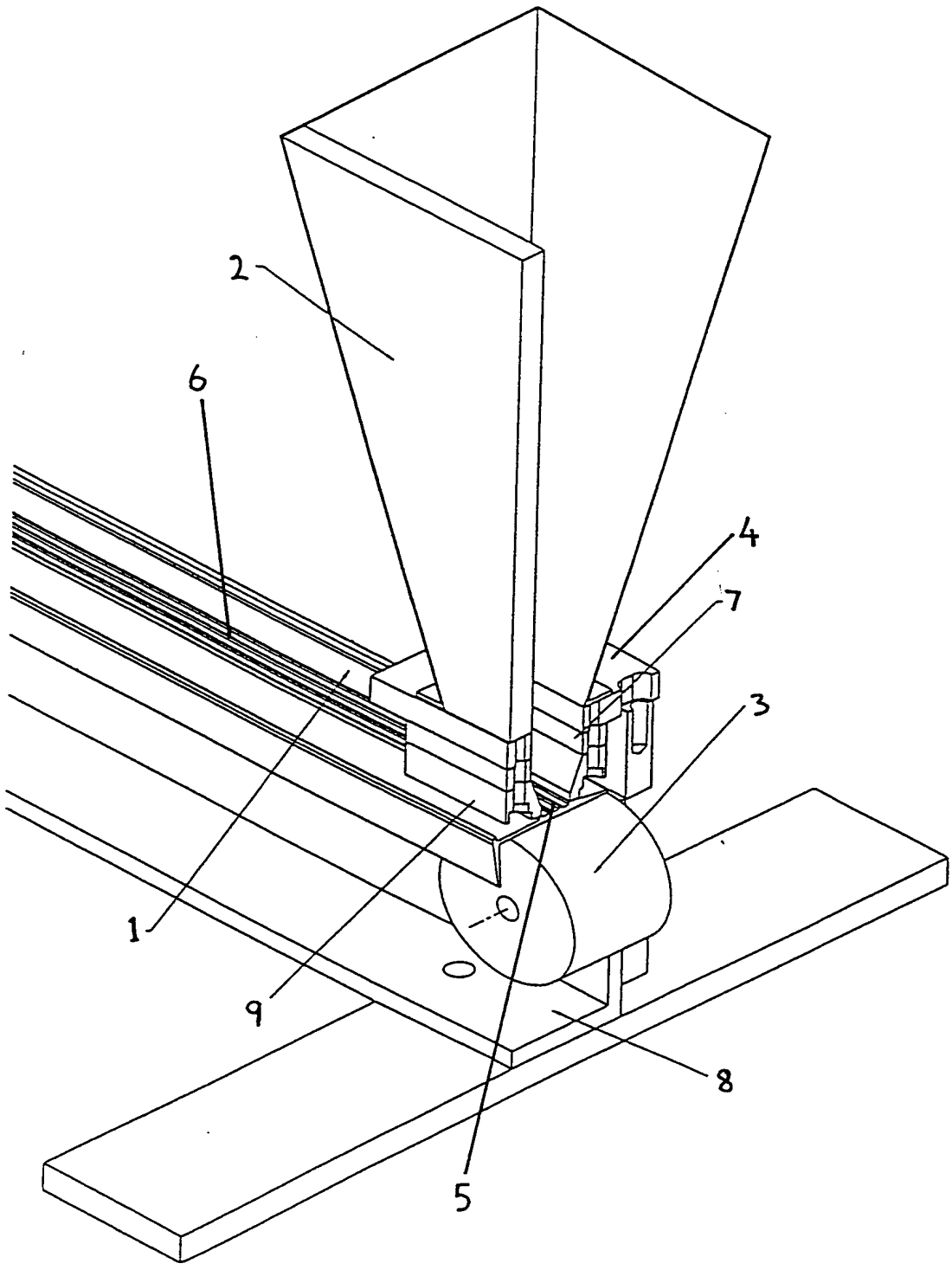

FIGURE 1

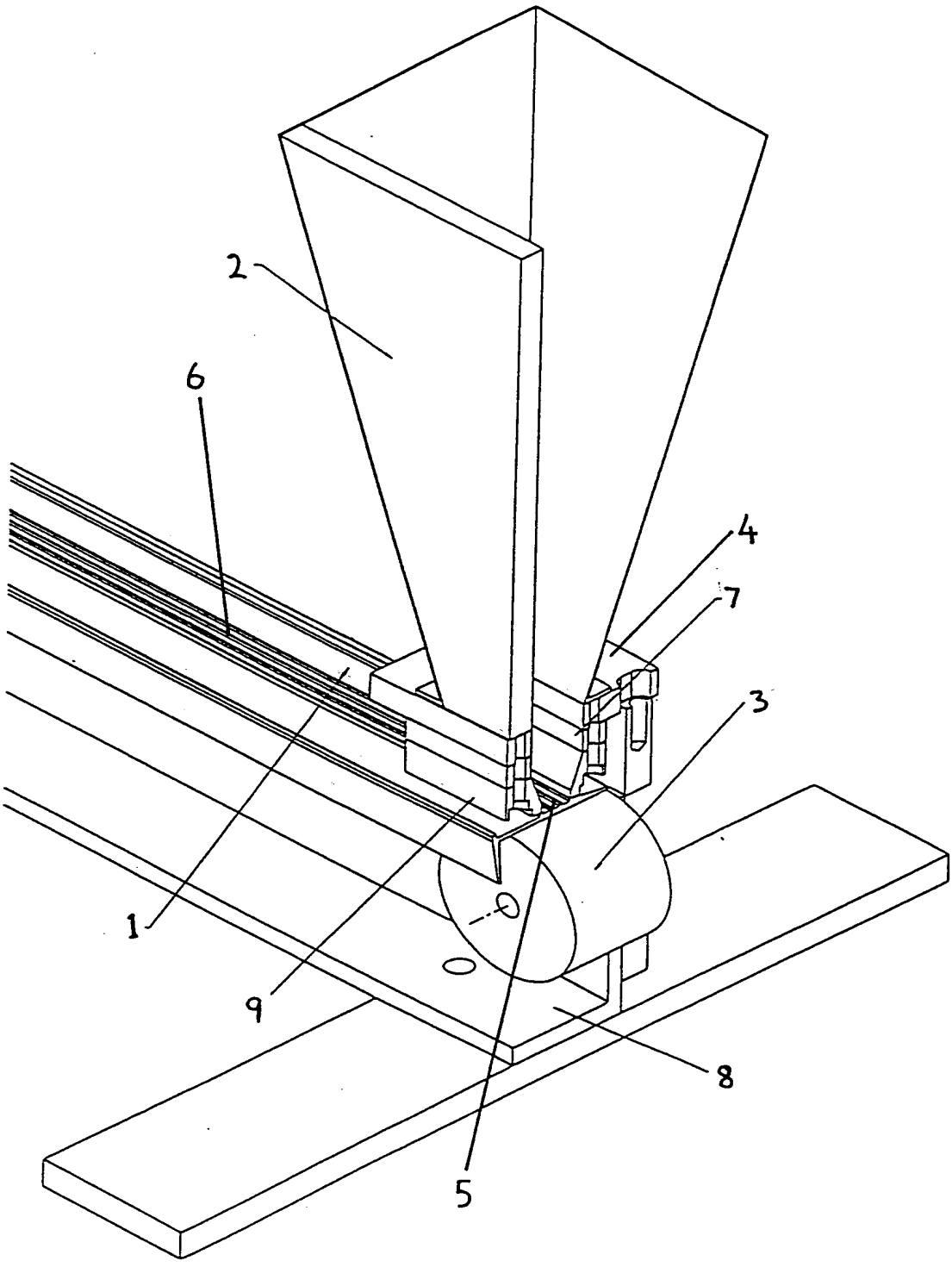

FIGURE 1